MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

ECE 3086 – MULTIMEDIA TECHNOLOGIES AND APPLICATIONS

(All sections / Groups)

17 NOV 2015
2.30 PM – 4.30 PM
(2 HOURS)

INSTRUCTION TO STUDENTS

1. This question paper consists of 6 pages (including cover page) with 5 questions.
2. Attempt all **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer Booklet provided.

QUESTION 1

(a) Compute the minimum average number of bits per symbol that can be achieved with variable length coding for the symbols set {W, X, Y, Z} if each of the symbol has equal probability. Is it possible to use a variable length code in this case? Discuss the justification of your answer.

[4 Marks]

(b) The pixel value of the image shown in Figure 1 is quantized with the use of Equation 1. The variable r and c represents the row and column index of the pixel. The round ( ) function maps floating point number to the nearest lower integer number.

$$y(r,c) = \text{round}\,(y(r,c)/5) \quad (1)$$

Compute the reconstructed image. Suggest one method to reduce reconstruction error.

[6 Marks]

212	212	212
12	154	154
12	154	154

Figure 1

Continued ...

QUESTION 2

(a) Use LZW algorithm to encode or compress the string "babanaba". Determine the encoder output code after compression. Use Table 1 as reference.

[6 marks]

Table 1

Current symbol S	Next symbol C	S+C	Encoder Output	Dictionary a – 1 b - 2 n – 3 Symbol Code

(b) Compute the compression ratio obtained by the encoder in question 2(a) by assuming that 12 bits fixed-length code is used before and after compression.

[2 marks]

(c) What is the difference between lossless and lossy compression? Give one example for a lossless and lossy compression algorithm.

[2 Marks]

Continued ...

QUESTION 3

(a) In order to achieve high compression and maintaining high perceptual quality, JPEG utilizes two major observations about human vision system. Identify the two major observations and discuss how it is used to increase compression rate.

[4 Marks]

(b) Figure 2 shows the quantized DCT coefficients matrix for an 8 x 8 image block. Obtain the run length code of the extracted AC coefficients. The run length code format is (Run, Value).

[4 Marks]

32	6	-1	0	0	0	0	0
-1	0	0	0	0	0	0	0
-1	0	1	0	0	0	0	0
-1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Figure 2 : Quantized DCT Coefficients

(c) Compute the new pixel value for the center pixel after the image in Figure 3 is applied with the 3x3 mean filter.

[2 Marks]

90	90	70
85	**100**	100
85	100	70

Figure 3

Continued...

QUESTION 4

(a) Figure 4 below shows the basic perceptual encoder used in MPEG-1 audio compression algorithm. Discuss the role of the psychoacoustic modeling in the compression scheme.

[4 Marks]

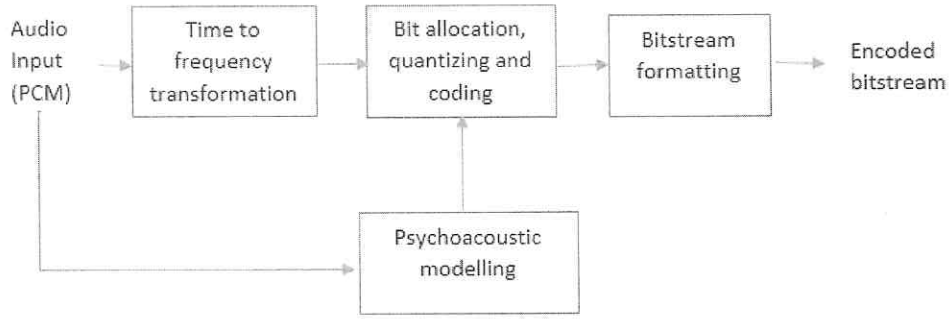

Figure 4

(b) Given the following Differential Pulse Code Modulated (DPCM) sequence e_n, reconstruct or decode back the original signal f_n. The error signal is given as e_n = [4, 2, 3, −2]. The underlined sample represents e_0. Assume that the signal start with the predicted value $\hat{f}_0 = 0$ (n=0). The following prediction scheme is used. f_n represents the samples at time n.

$$\hat{f}_n = f_{n-1}$$
$$e_n = f_n - \hat{f}_n$$

[4 Marks]

(c) Explain the benefit of using DPCM when compared to the conventional Pulse Code Modulation (PCM)

[2 Marks]

Continued...

QUESTION 5

(a) Video compression algorithm converts raw video frame into either I, P or B frames

i) With the use of a suitable diagram, explain how the I frame is obtained.
[4 Marks]

ii) Discuss why using only I frames results in low video compression rate. Propose a suggestion to improve compression rate.
[2 Marks]

b) Figure 5 shows the Y, I and Q planes from a single colour video frame. Assuming 4:2:2 colour subsampling, show the 3 YIQ planes after colour subsampling. Discuss justification for the use of colour subsampling.
[4 Marks]

128	126	127	129
124	123	124	124
130	136	132	132
154	143	132	132

Y

55	66	54	54
56	57	56	56
45	56	58	49
34	36	39	37

I

44	44	55	55
44	44	55	55
34	34	36	35
35	35	34	34

Q

Figure 5

End of Paper